

Volume 23

Study No. G-I

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

INVENTORY AND CATALOGING OF THE SPORT FISH AND
SPORT FISH WATERS IN SOUTHWESTERN ALASKA

by

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RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations
of Alaska

Project No.: F-9-14

Study No.: G-I Study Title: INVENTORY AND CATALOGING

Job No.: G-I-B Job Title: Inventory and Cataloging
of the Sport Fish and
Sport Fish Waters in
Southwestern Alaska

Cooperators: John B. Murray

Period Covered: July 1, 1891 to June 30, 1982

ABSTRACT

Karluk Lagoon weir escapement from May 20 to September 22, 1981, was comprised of: 2,195 steelhead trout kelts, Salmo gairdneri Richardson; 7,575 chinook salmon, Oncorhynchus tshawytscha (Walbaum); 24,792 coho salmon, Oncorhynchus kisutch (Walbaum); 51,248 pink salmon, Oncorhynchus gorbuscha (Walbaum); 222,706 sockeye salmon, Oncorhynchus nerka (Walbaum); 286 chum salmon, Oncorhynchus keta (Walbaum); and 164 upmigrant adult steelhead trout. Age-growth data for Karluk River chinook salmon and a summary of the weir count are presented.

Population estimates derived by mark and recaptures indicate Age I rainbow trout (Swanson River strain) stocked as fingerlings (1,005/kilograms) in five Kodiak lakes survived at a rate of 14.0 to 43.7 percent. Stocking studies indicated rainbow trout fingerlings acclimated and fed for 8 days in Lilly Pond, and Margaret Lake had 10.2 and 6.7 percent higher survival respectively than fish released immediately. Fingerlings held for 24 hours in Long Lake had only 1.2 percent higher survival than fingerlings released immediately. Coho salmon (741/kilogram) stocked every other year in Southern Lake had a 45.2 percent survival rate at Age I+. All stocked rainbow trout and coho salmon reached a catchable size (139.4-229.0 millimeters) at Age I+ and are expected to enter the sport fishery at Age II. Insufficient numbers of Arctic grayling, Thymallus arcticus (Pallas), Dolly Varden, Salvelinus malma (Walbaum), and large rainbow trout were captured to compute population estimates. A summary of age-growth data for all fish is presented.

The morphoedaphic index value determined for 10 lakes ranged between 23 and 10.0. Mayflower Lake, which was inundated by the 1964 tsunami, was found to contain seawater below mid-depth.

A total of 134,784 chinook salmon fingerlings (weight = 808.4/kilogram) were stocked in Lake Rose Tead on May 27, 1981. Information from aerial

surveys and a creel census indicated a minimum of 80 adult chinook salmon returned from the 1976-1980 annual plants. The 1981 sport catch (number = 38) comprised of 73.7 percent Age 1.3 fish that returned from the 133,109 fingerlings stocked in 1977. Approximately 41,000 and 126,000 chinook salmon eggs, were taken from Lake Rose Tead and Chignik River, respectively, for stocking in 1982. Summaries of chinook salmon age-growth and sex composition are presented.

A creel census conducted on Buskin River between April 21 and May 19 indicated 4,222 anglers fished 7,816 hours and harvested 8,437 Dolly Varden (mean length = 294.1 millimeters, number = 799).

Peak salmon escapement counts in 18 northeast Kodiak Island streams during 1981 indicated a minimum escapement of 307,600 pink salmon, 53,905 sockeye salmon, 12,210 chum salmon and 6,845 coho salmon.

KEY WORDS

Kodiak, sport fishery, rainbow, char, salmon, harvest, sport effort, escapement, and stocked lakes.

BACKGROUND

Region IV is comprised of the Kodiak-Afognak Island group and the Alaska Peninsula, south of a line from Cape Douglas to Port Heiden, including the Aleutian Islands. The Kodiak Island complex (Figure 1) is approximately 200 km long by 120 km wide. The Alaska Peninsula section is 1,600 km long extending 800 km into the Bering Sea. The area is mountainous, with numerous bays, lakes and streams and contains both anadromous and resident fish. Much of the area has not been surveyed and the total number of fish-producing waters is unknown. Kodiak Island has over 1,609 km of coastline, over 1,000 lakes 4 ha or larger in size and 229 known anadromous fish streams.

A fish stocking programs for Kodiak area lakes was initiated in 1953 and has continued to the present. In order to develop more successful programs, numerous lakes have been chemically rehabilitated and stocked with various fish species at differential rates. Different sizes of fish have been tested and various habitat conditions have been studied to determine optimal growth and survival.

The physical and biological condition of lakes on northeast Kodiak Island has been examined in some detail and the results of these observations are shown in Annual Federal Aid in Fish Restoration Reports 1953-1980. Priority for research, stocking and general survey work has been oriented toward these areas.

Past stream research has centered on waters with steelhead trout, rainbow trout, coho and chinook salmon. Substantial increases recently in fishing effort suggest these studies should be intensified. This report presents specific stream temperatures, stream flow and relevant stream data which



Figure 1. Map of the Kodiak-Afognak Island Group. Scale 1" = 17.5 miles

will form the basis for identifying programs to determine carrying capacity and areas of critical habitat for salmon, Dolly Varden and trout.

The Federal Aid in Fish Restoration Reports for the Kodiak area from 1953 to the present depicts specific data concerning the size, age and growth rate of coho, chinook and sockeye salmon, Dolly Varden, rainbow trout and steelhead trout from the Kodiak area. Additional data concerning harvest rates and spawning escapement are also presented. These data form the foundation for most sport fish management decisions and for recommendations pertaining to land use activities which may affect respective Kodiak area fisheries.

Table 1 presents a list of the fishes observed or studied in this report.

RECOMMENDATIONS

1. A creel census should be conducted on the Karluk and Pasagshak Rivers in 1982 to determine angler effort and harvest of Dolly Varden, chinook salmon and rainbow/steelhead trout.
2. The fish-producing waters on Afognak and Shuyak Islands, that remain as public waters (following total implementation of the Alaska Native Claims Settlement Act), should be surveyed.
3. Survival, growth and quality of fishing produced by various fish species and races that have been stocked in Kodiak and Afognak Island lakes should be evaluated.
4. A study should be implemented to determine the salmonid carrying capacity of Roslyn Creek, Olds River, American River, Salomie Creek, Buskin River and Lake Rose Tead.
5. A study should be developed to determine the Dolly Varden population sizes in Kodiak roadside streams and the optimum allowable sport harvest.
6. A creel census should be conducted on Portage Creek in 1982 to determine angler effort and harvest of Dolly Varden, rainbow trout and salmon.
7. Hydrographic mapping of selected roadside lakes should be conducted to determine volume, mean depths and morphoedaphic index values.

OBJECTIVES

1. To determine the physical, chemical and biological characteristics of existing and potential sport fishing streams and lakes in the Kodiak area.
2. To establish magnitude, distribution, timing, yearly fluctuations and angler harvest of sport fish populations on Kodiak Island, Afognak Island and areas of concern to sport fisheries management on the Alaska Peninsula.

Table 1. List of Common Names, Scientific Names and Abbreviations Used in this Report.

Common Name	Scientific Name and Author	Abbreviation
Arctic grayling	<u>Thymallus arcticus</u> (Pallas)	GR
Chinook salmon	<u>Oncorhynchus tshawytscha</u> (Walbaum)	KS
Chum salmon	<u>Oncorhynchus keta</u> (Walbaum)	CS
Coho salmon	<u>Oncorhynchus kisutch</u> (Walbaum)	SS
Dolly Varden	<u>Salvelinus malma</u> (Walbaum)	DV
Flatfish	Pleuroncetidae family	...
Pink salmon	<u>Oncorhynchus gorbuscha</u> (Walbaum)	PS
Rainbow trout	<u>Salmo gairdneri</u> Richardson	RT
Sockeye salmon	<u>Oncorhynchus nerka</u> (Walbaum)	RS
Steelhead trout	<u>Salmo gairdneri</u> Richardson	SH
Threespine stickleback	<u>Gasterosteus aculeatus</u> Linnaeus	TS
Sculpin	<u>Cottus</u> sp.	SC

3. To investigate, evaluate and develop plans for the enhancement of anadromous and resident fish stocks.

TECHNIQUES USED

Standard techniques described by Murray and Van Hulle (1981) were used in age analysis, determination of fish size, escapement counts, harvest estimates and in collection of stream flows and temperatures.

Fish population estimates in all lakes were made by Robson and Regier's (1967) mark and multiple recapture estimator of the Peterson estimator (Ricker, 1970). Fish were captured for sampling and marking by fyke nets of the following size: length = 3.7 m; diameter = 1 m and two wings measuring 1.2 m x 7.6 m. Two square aluminum frames and five aluminum hoops support the entrance and body of the fyke net. The wings, body and internal throats are constructed of 9.5 mm square mesh knotless nylon. In Delphin Bay Lake, variable mesh monofilament gill nets (38.1 m x 1.8 m), composed of five different net panels (7.6 m long) with mesh ranging in size from 12.7 mm to 50.8 mm bar measure, were used to sample Dolly Varden and rainbow trout.

All rainbow trout captured by fyke traps were anesthetized, sampled for age-growth data, marked with a caudal clip and then released in the center of the lake for dispersion.

Rainbow trout stocking studies were conducted in Bull and Long Lakes during 1980. One-half of the fingerlings were released immediately in the lake and the other half were held and fed for a 24-hour acclimation period. Similar studies were conducted in Lilly Pond and Margaret Lakes; except the acclimated fish were held and fed for 8 days. All fish were given a fin clip identification mark except the Margaret Lake rainbow trout that were released immediately. Fish survival and growth were determined in 1981 by the formerly described techniques.

The morphoedaphic index (MEI) value of 10 lakes was determined by dividing specific conductance of lake water by mean depth of the lake.

Water characteristics (total hardness, total alkalinity, dissolved oxygen, pH, temperature, salinity and conductivity) were determined with a DR-EL Hach Kit or model 33 Yellow Stone Instrument. Mayflower Lake bottom samples were taken with a 228.6 mm x 228.6 mm Ekman dredge.

FINDINGS

Lake and Stream Surveys

Abercrombie Lake:

Abercrombie Lake has been stocked annually with rainbow trout and periodically with Arctic grayling since it was chemically rehabilitated in 1972. It was stocked with 3,695 adipose-clipped rainbow trout (Swanson River Strain, wt = 1,005/kg) on August 25, 1980. Five fyke nets set for

467.5 trap-hours from October 5-9, 1981 captured: 3 Age 0, 810 Age I, 3 Age II rainbow trout and 17 Arctic grayling. The population estimate for Age I rainbow trout (Table 2) was $1,616 \pm 85$ fish with an estimated survival rate of 43.7%. Insufficient numbers of Age 0 rainbow trout, Age II rainbow trout and grayling were captured to compute a valid population estimate. The low catch of Age II rainbow trout is probably due to exploitation by the sport fishery and net avoidance. Age-growth data presented in Table 3 indicated 270 Age I rainbow trout averaged 197.2 mm and 87.4 g, while Age 0 and Age II rainbow trout, averaged 104 mm and 322 g, respectively. The grayling sampled contained 13 Age II and four Age III fish with respective mean lengths of 223.7 mm and 285.0 mm and weights of 125.4 g and 273.0 g.

Abercrombie Lake is located in the only State park on Kodiak and, therefore, is one of the heavily utilized lakes. Rainbow trout stocked in previous years at approximately 1,000 to 1,500 fish per kilogram and 250 to 488 fish per hectare have reached a catchable size at Age I+. Murray and Van Hulle (1981) determined the Age 0+ rainbow trout in 1980 had a 55.8% survival rate after 7 weeks residency. At Age I+, the survival rate was 43.7% or 12.1% additional mortality. These fish are now catchable (\bar{x} ln. = 197.2 mm) and will probably be fished out by next fall.

Delphin Bay Lake #13566:

Delphin Bay Lake was initially surveyed in 1974 and determined to be an excellent experimental lake for stocking rainbow trout (Murray and Van Hulle, 1975). It was chemically rehabilitated (0.5 ppm Pronox Fish) in September 1978 and stocked with 3,695 Swanson River rainbow trout (wt = 1,516/kg) on September 19, 1979. A gabion fish barrier installed on the lake outlet in October 1978 washed out and was replaced in June 1980. Fish immigration may have occurred while the barrier was inoperable; however, Dolly Varden were captured in the lake after rehabilitation and prior to the washout (Ralph Browning, USFS, pers. comm., 1979) thus indicating an incomplete fish kill. Dolly Varden were also observed throughout the system during a September 26-29, 1981 survey, while threespine stickleback were seen only in the outlet below a 1 meter falls. Fyke net traps and gillnets fished for 360 hours captured 45 Dolly Varden (\bar{x} ln. = 212.0 mm, x = 298.0 g), no threespine stickleback and 12 Age II rainbow trout (\bar{x} ln. = 377.3 mm). The low capture rate for Age II+ rainbow trout sampled for maturity had a mean fecundity of 2,387 eggs and four males had large, well developed testes. These fish will spawn in May 1982. Since Lake #13566 is remote and unexploited, and the coho salmon Age I+ population size was $1,150 \pm 43$ (Murray and Van Hulle, 1981), there is probably enough mature rainbow trout to support a small egg take.

Delphin Bay Lake #13566 was the first water ever chemically rehabilitated on Afognak Island and subsequently stocked with rainbow trout. At Age I, these fish demonstrated sufficient growth and survival rates to provide an excellent sport fishery (Murray and Van Hulle, 1980) and, at Age II, they were the largest (\bar{x} ln. = 377.3 mm) of any rainbow trout stocked on Kodiak Island. Since Lake #13566 is remote and exploitation is light, this information may be used as base line data for stocking other Afognak Island lakes, assuming lake productivities are relatively similar.

Table 2. Population Estimates of Abercrombie Lake Rainbow Trout (Age I) from a Sequence of Four Samples, October 5 through October 9, 1981.

Sample	Catch	Experimental Results				Summary Statistics		Estimates
		Marked Recaptures	Number Dead or Injured on Capture	Number of Marked Released	Unmarked Catch	Cumulative Unmarked Catch	Number Previously Dead or Injured	N+S.E. (N)
1	441	0	1	440	441	441	0	0 ± 0
2	219	35	0	219	184	625	1	2,754 ± 410
3	277	124	0	277	153	778	1	1,653 ± 98
4	68	36	0	68	32	810	1	1,616 ± 85

Table 3. Sampling Summary of Kodiak-Afognak Island Lakes, 1981.

Water Name & Location	Date Sample	Species*	Number Sampled	Age	Length (mm)		Weight (g)		Population Estimate		Percent Survival	Date Stocked	Number Stocked	Per kg	Per ha
					\bar{x}	\pm S.D.	\bar{x}	\pm S.D.	Number	\pm S.E.					
Abercrombie T27S, R19W Sec. 15	10/5 thru 10/9	RT	3	0	104.0	10.4	14.6	4.2	NE	...	NE	Natural Reproduction			
		RT (S,A)	270	I	197.2	25.6	87.4	35.2	1,616	85	43.7	8-25-80	3,695	1,005	488
		RT (S)	3	II	322.0	12.5	368.3	28.8	NE	...	NE	9-13-79	1,900	1,504	251
		GR (T)	13	II	223.7	13.5	125.4	20.7	NE	...	NE	Natural Reproduction			
Bull Lake T31S, R20W Sec.35	8/30- 9/5 10/3	GR (T)	4	III	285.0	13.5	273.0	43.8	NE	...	NE	6-12-78	10,000	Fry	1,321
		RT (S,LV)	37	I	197.4	31.1	85.3	39.3	NE	...	NE	8-25-80	1,432	1,005	358
		RT (S,RV)	46	I	197.0	26.4	80.7	32.9	NE	...	NE	8-25-80	1,495	1,005	374
		RT (S,NC)	12	I	196.4	43.1	90.6	36.6	NE	...	NE	8-25-80	NE	1,005	...
Delphin Bay Lake #13566 T21S, R19W Sec. 30	9/26 thru 9/29	RT (S)	1	II	325.0	...	386.0	...	NE	...	NE	9-13-79	1,000	1,504	250
		RT (S)	12	II	377.3	32.9	NE	...	NE	...	NE	3-19-79	3,695	1,516	366
		DV	45	NA	212.0	66.2	298.0	131.0	NE	...	NE	Natural Reproduction			
		RT (S,A)	34	I	170.9	30.1	58.1	34.7	NE	...	NE	8-25-80	2,798	1,005	483
Lee Lake T28S,R21W Sec. 36	8/10-14 & 10/2	RT (S,NC)	6	NA	231.0	20.4	133.0	38.5	NE	...	NE	8-25-80	NE	...	...
		RT (S)	7	II	301.3	25.3	299.8	72.7	NE	...	NE	9-13-79	1,400	1,504	242
		DV	32	NA	202.8	55.3	106.0	78.5	NE	...	NE	Natural Reproduction			
		RT (S,LV)	105	I	223.7	15.5	118.2	25.7	191	NE	38.2	8-27-80	500	1,005	156
Lilly Pond T28S, R20W 9/19	9/5-9/9 & 9/19	RT (S,RV)	91	I	223.6	15.2	117.8	25.3	140	NE	28.0	8-27-80	500	1,005	156
		RT (S,NC)	7	I	229.0	24.0	130.6	38.1	24	NE	NE	8-27-80	NE	1,005	...
		RT (S)	3	II	285.7	22.9	...	...	NE	...	NE	9-13-79	2,100	1,504	656

Table 3. (cont'd) Sampling Summary of 9 Kodiak-Afognak Island Lakes, 1981

Water Name & Location	Date Sample	Species*	Number Sampled	Age	Length(mm)		Weight(g)		Population Estimate		Percent Survival	Date Stocked	Number Stocked	Per kg	Per ha
					x	+S.D.	x	+S.D.	Number	+S.E.					
Long Lake	10/13-16	RT (S,LV)	97	I	139.4	18.9	28.9	12.8	582	43	21.4	8-27-80	2,718	1,005	186
T27S, R19W	&	RT (S, RV)	112	I	140.6	19.9	30.3	15.3	545	34	20.2	8-27-80	2,697	1,005	185
Sec. 34	10/21	RT (S,NC)	22	I	139.7	21.1	28.4	12.0	78	17	...	8-27-80	NE	...	...
		RT (S)	43	II	233.8	21.3	133.2	40.2	NE	...	NE	9-14-79	3,600	1,504	247
		RT (S)	21	III	296.8	35.3	279.8	99.4	NE	...	NE	8-24-78	5,200	977	357
		RT (AE)	8	IV	360.7	25.6	461.3	109.4	NE	...	NE	6-21-77	2,689	1,098	184
		RT (O)	1	V	380.0	...	570.0	...	NE	...	NE	8-05-76	2,700	2,439	185
		GR (T)	14	III	248.3	12.4	156.0	15.4	NE	...	NE	6-12-78	10,000	Fry	686
		GR (T)	9	IV	252.0	11.5	170.2	16.7	NE	...	NE	6-21-77	10,000	Fry	686
		DV	9	NA	211.3	32.2	83.1	32.9	NE	...	NE	Natural Reproduction			
1 Margaret Lake	9/19	RT (S,A)	85	I	174.8	21.1	58.6	21.7	166	13	20.7	8-26-80	800	1,005	250
T28S, R20W	thru	RT (S,NC)	74	I	187.8	25.9	73.4	30.7	112	13	14.0	8-26-80	800	1,005	250
Sec. 11	9/23	DV	78	NA	208.9	48.8	106.1	64.4	331	97	NE	Natural Reproduction			
Southern Lake	10/9-13	SS	159	I	173.9	11.7	56.6	13.2	1,582	NE	45.2	5-28-80	3,500	741	493
T28S, R19W	&	SS	35	III	243.6	21.9	145.0	37.2	(Age III & IV pop. est. = 50)		NE	6-02-78	3,000	853	422
Sec. 14	10/23	SS	6	IV	316.0	18.1	306.7	54.4			NE	6-21-77	3,008	1,228	424
Tanignak Lake	10/23	RT (S)	333	I	172.7	26.3	57.4	26.3	1,899	70	34.7	8-27-80	5,476	1,005	455
T28S, R9W	thru	RT (S)	31	II	271.0	29.7	212.0	66.2	NE	...	NE	9-14-79	3,000	1,504	249
Sec. 3	10/26	RT (S)	20	IV	333.0	29.2	411.0	121.0	NE	...	NE	6-21-77	673	4,158	56

* Fish captured via fyke trap.

RT = Rainbow Trout
GR = Arctic Grayling
DV = Dolly Varden
SS = Coho Salmon
S = Swanson River Stock

AE = Alaska-Ennis Stock
O = Green River Oregon Stock
T = Tolsona
NE = No Estimate
NA = No Age of Regenerate Scales

A = Adipose clip
LV = Left ventral clip
RV = Right ventral clip
NC = No clip

Bull Lake:

Bull Lake was stocked with 2,927 rainbow trout (Swanson River strain, wt = 1,005/kg) on August 25, 1980. Approximately half the fish were marked with a right ventral (RV) fin clip and released immediately. The other half were marked with a left ventral (LV) fin clip, confined to a pen in the lake, fed for 24 hours and then released. Observed mortality on the pen-held fish was zero. Five fyke nets set in the lake August 30 through September 5 and again on October 3, 1981, for a total of 555 trap-hours caught 95 Age I rainbow trout comprised of 46 RV clips, 37 LV clips and 12 unmarked (UM) fish. One Age II rainbow was also captured. Insufficient numbers of fish were captured or recaptured to compute a population size, and the sample size was too small to evaluate the stocking technique. The presence of unmarked fish resulted from regenerated fins or an error in marking. Analysis of growth data, as presented in Table 3, indicated LV, RV and UM Age I rainbow trout had a mean size of approximately 197 mm and 85 g. These fish reached a catchable size in one growing season. The low fyke net catches probably resulted from the small population being fished prior to sampling.

Lee Lake:

Lee Lake was stocked with 2,798 rainbow trout (Swanson River strain, wt = 1,005/kg) on August 25, 1980. These fish were adipose-clipped to distinguish them from the rainbow trout population originating from a September 1979 stocking. Five fyke nets set in the lake August 10-14 and October 2, 1981, for 560 trap-hours, captured 47 rainbow trout comprised of Age I (n=34), Age II (n=7), six unageable fish and 32 Dolly Varden. An analysis of age-growth data presented in Table 3 indicated these fish had a mean length of 170.9 mm, 301.3 mm, 231.0 mm and 202.8 mm, respectively. The population sizes and survival rates were not determined as insufficient numbers of fish were captured or recaptured. However, it appears that few fish were in the lake. Fishing mortality, competition and stocking methods were probably not the reason for the apparent stocking failure. The nature of the trout and/or lake conditions may have caused these fish to migrate.

Long Lake:

Long Lake has been stocked annually with rainbow trout and periodically with Arctic grayling since it was chemically rehabilitated in 1973. In 1980, one-half (n = 2,697, wt. = 1,005/kg) of the rainbow fingerlings were marked with a right ventral (RV) fin clip and released immediately. The other half were marked with a left ventral (LV) fin clip, confined to a pen in the lake, fed for 24 hours and then released. Mortality on the pen-held fish prior to liberation was five. Approximately 1 year later, five fyke nets set in the lake from October 13-16 and October 21, for a total of 462.5 trap hours, captured 679 Age I and 73 Age II or older threespine stickleback. The population size of Age I rainbow trout as presented in Table 4 was 545 ± 34 RV-clipped rainbow, 582 ± 17 LV-clipped rainbow trout and 78 ± 17 unmarked rainbow trout with respective survival rates for the former two of 20.2% and 21.4%. Survival of unmarked fish was not determined. The mean size of Age I rainbow trout as presented in Table 3 was approximately 140 mm and 29 g with an overall survival rate of 22.3%. Insufficient numbers of grayling and Age II or older rainbow trout were

Table 4. Population Estimates of Long Lake Age I Rainbow Trout (Swanson River Strain), from a Sequence of Four Samples, October 13 through 16 and 21, 1981.

<u>Experimental Results</u>					<u>Summary Statistics</u>		<u>Estimates</u>
Sample	Catch	Marked Recaptures	Number of Marked Released	Un-Marked Catch	Cumulative Un-Marked Catch	Number Previously Dead or Injured	N+S.E. (N)
<u>Age I Rainbow Trout LV, (Held and Fed for 24 Hours when Stocked as Fingerlings):</u>							
1	97	0	97	97	97	0	0 + 0
2	130	16	130	114	211	0	788 + 168
3	95	33	95	62	273	0	660 + 74
4	85	45	85	40	313	0	582 + 43
<u>Age I Rainbow Trout, RV (Released Immediately when Stocked as Fingerlings):</u>							
1	112	0	112	112	112	0	0 + 0
2	114	17	114	97	209	0	751 + 155
3	98	40	98	58	267	0	574 + 57
4	118	60	118	58	325	0	545 + 34
<u>*Age I Rainbow Trout (Unknown Stocking Method):</u>							
1	22	0	22	22	22	0	0 + 0
2	9	2	9	7	29	0	99 + 59
3	10	2	10	8	37	0	123 + 52
4	11	7	11	4	41	0	78 + 17

LV = Left ventral fin clipped

RV = Right ventral fin clipped

* Stocking method unidentified as fin clips had regenerated

captured or recaptured to compute population sizes. The 14 Age III grayling catch probably resulted from threespine stickleback reinhabiting the lake and devouring the 1977 and 1978 sac fry transplants. Consequently, grayling will probably be eliminated from these waters by stickleback predation in the next 2 or 3 years. The nine Dolly Varden captured had a mean length of 211.3 mm with a range of 137-250 mm. The 43 Age II rainbow trout (Swanson River strain) averaged 233.8 mm and 133.2 g, while 21 Age III, eight Age IV and one Age V rainbow trout had respective mean lengths of 296.8 mm, 360.7 mm and 380.0 mm.

Long Lake and Abercrombie Lake are similar in size, geographic area and management history. They were both rehabilitated in 1973 and restocked with trout and grayling. The major differences in these lakes are that Abercrombie probably receives more fishing effort and stickleback have not been reestablished. It is significant that survival of Swanson trout to Age I was a minimum of 43.7% in Abercrombie Lake as opposed to the overall 22.3% in Long Lake. There could be other factors, however, and the presence of stickleback in Long Lake appears to be a significant factor in reduced survival for the stocked Swanson River trout. Survival of pen-held fingerling rainbow trout (21.4%), suggesting no advantage to acclimating fingerlings for 24 hours prior to stocking.

Lilly Pond:

Lilly Pond was stocked with 1,000 rainbow trout (Swanson River strain, wt = 1,005/kg) on August 25, 1980. One-half of the fish were marked with a right ventral (RV) fin clip and released immediately. The other half were marked with a left ventral (LV) fin clip, confined to a pen in the lake, fed for 8 days and then released. Mortality on the pen-held fish was three. Approximately 1 year later, five fyke nets set in the lake September 5-9 and September 19, 1981, for 505 trap-hours indicate 252 Age I rainbow trout comprised of 113 RV clips, 137 LV clips and 12 unmarked fish. Three Age II fish were also captured. Population sizes were determined by the Peterson estimator (Table 5), as a solution could not be found for the RV rainbow trout population in sampling period number 4 (Table 6) of the mark-multiple recapture estimate. The Peterson estimator indicated a population size of 191 LV-clipped and 140 RV-clipped rainbow with respective survival estimates of 38.2% and 28.0%. Both groups of fish had an approximate mean length and weight of 223 mm and 118 g. The population size for unmarked rainbow trout was 24 fish with a mean length and weight of 229.0 mm and 130.6 gm. The overall survival for Age I rainbow trout was 35.6%, which is excellent considering the lake supports an undetermined amount of angling effort. Holding and feeding the fish for 8 days increased survival to Age I by 10.2%. Although this stocking technique may not be practical in small ponds, it may be useful in stocking large lakes involving thousands of fish.

Margaret Lake:

Margaret Lake was stocked with 1,600 rainbow trout (Swanson River strain, wt = 1,005/kg) on August 26, 1980. One-half of the fish were released immediately without an identification mark. The other half were marked with an adipose clip, confined to a pen in the lake, fed for 8 days and then released. Mortality on the pen-held fish prior to liberation was 16.

Table 5. Population Estimates of Lilly Pond Age I Rainbow Trout (Swanson River Strain) Utilizing the Peterson Estimator and Data from a Sequence of Five Samples, September 5 through 9, 18 and 19, 1981.

Age I Rainbow Trout (Held and Fed Eight Days When Stocked as Fingerlings):

Peterson Estimator: $P = m(u+r)/r$

Population (P)	= 191	$P = 105 (32 + 39)/39$
Marked Fish (m)	= 105	$P = 191$
Unmarked Fish (u)	= 32	
Recaptured Fish (r)	= 39	

Age I Rainbow Trout (Released Immediately When Stocked as Fingerlings):

Peterson Estimator: $P = m(u+r)/r$

Population (P)	= 140	$P = 90 (22 + 40)/40$
Marked Fish (m)	= 90	$P = 140$
Unmarked Fish (u)	= 22	
Recaptured Fish (r)	= 40	

Age I Rainbow Trout (Unmarked):

Peterson Estimator: $P = m(u+r)/r$

Population (P)	= 24	$P = 8 (4 + 2)/2$
Marked Fish (m)	= 8	$P = 24$
Unmarked Fish (u)	= 4	
Recaptured Fish (r)	= 2	

Note: During stocking one-half the rainbow fingerlings were held and fed for eight days and the other half was released immediately.

Table 6. Population Estimates of Lilly Pond Age I Rainbow Trout (Swanson River Strain), From a Sequence of Five Samples, September 5 through 9 and 19, 1981.

		<u>Experimental Results</u>			<u>Summary Statistics</u>		<u>Estimates</u>
Sample	Catch	Marked Recaptures	Number of Marked Released	Un-Marked Catch	Cumulative Un-Marked Catch	Number Previously Dead or Injured	N+S.E. (N)
<u>Age I Rainbow Trout (Held and Fed for 24 Hours when Stocked as Fingerlings):</u>							
1	23	0	23	23	23	0	0 + 0
2	28	3	28	25	48	0	215 + 109
3	30	2	30	28	76	0	426 + 174
4	36	7	36	29	105	0	404 + 103
5	71	39	71	32	137	0	225 + 21
<u>Age I Rainbow Trout (Released Immediately when Stocked as Fingerlings):</u>							
1	17	0	17	17	17	0	0 + 0
2	30	1	30	29	46	0	510 + 486
3	22	0	22	22	68	0	1,537 + 1,520
4	27	4	27	23	90	0	* No Estimate
5	62	40	62	22	113	0	No Estimate

* Iterative solution not found after 100 iterations for sampling period No. 4.

Note: During stocking one-half the rainbow fingerlings were held and fed for eight days and the other half was released immediately.

Approximately 1 year later, five fyke nets set in the lake September 19-23, 1981, for 462.5 trap-hours, caught 191 Age I rainbow trout and 84 Dolly Varden. The population estimate as presented in Table 7 was 166 adipose-clipped (\bar{x} ln = 174.8, \bar{x} wt = 58.6 g) and 112 unmarked (\bar{x} ln = 187.8, \bar{x} wt = 73.4 g) rainbow trout. Survival estimates for these fish were 20.7% and 14.0%, respectively. The overall survival for Age I rainbow trout was 17.4%. The Dolly Varden population size was 331 ± 97 fish with a mean size of 208.9 mm and 106.1 g.

Holding and feeding the rainbow trout for 8 days increased survival over fish released immediately by 6.7%. This increase would have been higher if: 1) Pen-held fish were not marked; i.e., there is a higher mortality on marked fish; and 2) the numbers of regenerated adipose fins could have been determined, i.e., clipped fins do regenerate and/or are occasionally missed.

The 17.4% overall survival rate appears low considering the absence of competition, low stocking density (250/ha) and presumed low exploitation. One possible explanation for the low survival may have been due to excessive turbidity caused by colloidal fines washing into the lake from the new highway. However, the growth rate (fry to approximately 180 mm) was sufficient to produce a catchable or near catchable fish in one growing season. The increased survival of the pen-held fish fortifies the Lilly Pond experiment, suggesting this technique may be practical for stocking large lakes with fingerling rainbow trout.

Southern Lake:

Southern Lake has been stocked annually with coho salmon from 1971-1978 and semi-annually since 1980 ($n=3,500$, wt = 741/kg). The lake has never been chemically rehabilitated and it contains a large population of threespine stickleback. Fyke net trapping during October 9-13 and October 23, 1981, captured 389 landlocked coho salmon in 552.5 trap-hours. Age I ($n=159$), Age III ($n=35$) and Age IV ($n=6$) fish were represented in the sample with respective mean lengths of 173.9 mm, 243.6 mm and 316.0 mm. Population size was determined by the Peterson estimator (Table 8) as a solution for could not be found population size in sampling period number 5 (Table 9) in the mark-multiple recapture estimate. The population estimates for two size classes of fish identified in the field were 1,582 Age I coho salmon (≤ 200 mm) and 50 Age II and Age III coho salmon (> 200 mm). The latter population estimate broken down by a percentage of each age class sampled (Age III = 85.4%, Age IV = 14.6%) yielded 43 Age III and seven Age IV landlocked coho salmon. The latter two population sizes are underestimated, since Age II and older fish are difficult to capture and/or recapture. Survival rate for Age I coho was 45.2%.

The benefits or drawbacks of stocking coho salmon in Southern Lake on alternative years is unclear; e.g., Age I coho salmon sampled from 1972 through 1979 had a mean length range of 162-179 mm (Murray and Van Hulle, 1973-1980), while 1981 coho salmon averaged 173.9 mm. Age I survival in 1979 and 1981 was 31.5% and 45.2%, respectively, or 13.7% higher for the alternate year. However, the 45.2% survival spread out over a 2-year period (alternate year stocking) is only 22.6%, or 8.9% less survival. In

Table 7. Population Estimates of Margaret Lake Dolly Varden (all age classes) and Age I Rainbow Trout from a Sequence of Four Samples, September 19 through September 23, 1981.

		<u>Experimental Results</u>				<u>Summary Statistics</u>		<u>Estimates</u>
Sample	Catch	Marked Recaptures	Number	Number of Marked Released	Un-Marked Catch	Cumulative Un-Marked Catch	Number Previously Dead or Injured	N+S.E. (N)
			Dead or Injured on Capture					
<u>Dolly Varden:</u>								
1	17	0	0	17	17	17	0	0 + 0
2	37	1	0	37	36	53	0	629 + 601
3	22	3	0	22	19	72	0	446 + 206
4	17	5	0	17	12	84	0	331 + 97
<u>Age I Rainbow Trout LV, (Held and Fed for Eight Days when Stocked as Fingerlings):</u>								
1	45	0	2	43	45	45	0	0 + 0
2	48	8	0	48	40	8	2	260 + 75
3	33	19	0	33	14	99	2	175 + 23
4	48	30	0	48	18	117	2	166 + 13
<u>Age I Rainbow Trout RV, (Released Immediately when Stocked as Fingerlings):</u>								
1	27	0	1	26	27	27	0	0 + 0
2	29	5	0	29	24	51	1	152 + 55
3	22	8	0	22	14	65	1	143 + 30
4	27	18	0	27	9	74	1	112 + 13

LV = Left Ventral Fin Clipped
RV = Right Ventral Fin Clipped

Note: During stocking one-half the rainbow fingerlings were held and fed for eight days and the other half was released immediately.

Table 8. Population Estimates of Southern Lake Landlocked Coho Salmon Utilizing the Peterson Estimator and Data From a Sequence of Five Samples, October 9-13, 22 and 23, 1981.

Age I Landlocked Coho Salmon:

Peterson Estimator: $P = m(u+r)/r$

Population (P)	= 1,582	$P = 284 (64 + 14)/14$
Marked Fish (m)	= 284	$P = 1,582$
Unmarked Fish (u)	= 64	
Recaptured (r)	= 14	

Age III & IV Landlocked Coho Salmon:

Peterson Estimator: $P = m(u + r)/r$

Peterson (P)	= 50	$P = 37 (4 + 11)/11$
Marked Fish (m)	= 37	$P = 50$
Unmarked Fish (u)	= 4	
Recaptured (r)	= 11	

Table 9. Population Estimates of Southern Lake Landlocked Coho Salmon from a Sequence of Five Samples, October 9 through 13, 22 and 23, 1981.

<u>Experimental Results</u>					<u>Summary Statistics</u>		<u>Estimates</u>
Sample	Catch	Marked Recaptures	Number of Marked Released	Un-Marked Catch	Cumulative Un-Marked Catch	Number Previously Dead or Injured	N+S.E. (N)
<u>Age I Landlocked Coho:</u>							
1	64	0	64	64	64	0	0 + 0
2	96	1	96	95	159	0	6,144 + 5,717
3	74	2	74	72	231	0	5,969 + 3,745
4	55	2	55	53	284	0	6,123 + 2,688
5	78	14	78	64	348	0	*No Estimate
<u>Age II & III Landlocked Coho:</u>							
1	6	0	6	6	6	0	0 + 0
2	19	3	19	16	22	0	38 + 14
3	18	9	18	9	31	0	43 + 6.8
4	7	1	7	6	37	0	58.7 + 10.5
5	15	11	15	4	41	0	53.9 + 6.0

* Iterative solution not found after 100 iterations for sampling Period No. 5.

essence, alternate year stocking may produce similar sized but fewer Age I coho salmon.

Tanignak Lake:

Tanignak Lake was stocked with 5,476 rainbow trout (Swanson River strain wt = 1,005/kg) on August 27, 1980. It contained a threespine stickleback population and a rainbow trout population of unknown size. It was previously stocked with rainbow trout in 1977 and 1979. Five fyke nets set in the lake October 23-26, 1981, for 352.5 trap-hours, captured 1,114 Age I (\bar{x} ln = 172.7 mm, \bar{x} wt = 57.4 g) 55 Age II (\bar{x} wt = 411.0 g) rainbow trout. The population estimate for Age I fish (Table 10) was $1,899 \pm 70$, with an estimated survival rate of 34.7%. Insufficient numbers of Age II and IV rainbow trout were captured to compute a population size.

Growth and survival of rainbow trout to Age I in Tanignak Lake is superior to any Kodiak water infested with threespine stickleback. The only observed difference between it and other lakes is the numerous submerged trees throughout much of the bottom and shoreline. This additional cover may provide a substrate for aquatic organisms (more fish food) and shelter for small fish, both of which might increase survival.

Mayflower Lake:

Mayflower Lake was inundated by seawater during the 1964 tsunami (Lall, Marriot, Spetz and Simons, 1965) and currently remains saline below mid-depth. Salinity measurements (Table 11) recorded August 13, 1981 were 0.75 ppt at 4.9 m compared to 10.0 ppt at 4.6 m recorded on December 12, 1970 and July 10, 1975 (Murray and Van Hulle, 1971, and 1976). Salinities near the bottom (8.2 m) were 9.0 ppt on August 31, 1981 and 16.5 ppt on both December 12, 1970 and July 10, 1975 (Murray and Van Hulle, 1971, 1976). Analysis of bottom samples collected with an Elman dredge on August 28 and 31, 1981 indicated freshwater plant and animal life did not exist in the saltwater strata. Samples collected from depths of 7.3 m and 8.2 m contained strong hydrogen sulfide gas odors, characteristic of stagnant mineral water.

The presence of saltwater over the last 18 years appears to have reduced the production of Mayflower Lake. It appears it will be a number of years yet before the salinity dissipates and the lake is again capable of optimum fish production.

Roadside Stream Flows and Temperatures

Stream flows and water temperatures were collected during 1981 from five roadside streams to determine relative fluctuations in the stream discharge and the annual thermal units produced by each stream. Monthly flow readings for American River, Buskin River, Olds River, Roslyn Creek and Salonie Creek (Figures 2 and 3) indicate the highest flow occurred in Buskin River (16.9 cms) and the lowest in Roslyn River (0.2 cms). Generally speaking, flows were high in June and September and lower during August and winter months. These findings are similar to those of 1979 and 1980 (Murray and Van Hulle, 1980-1981) suggesting annual winter and mid-summer low flow period with freshets occurring in the spring and fall.

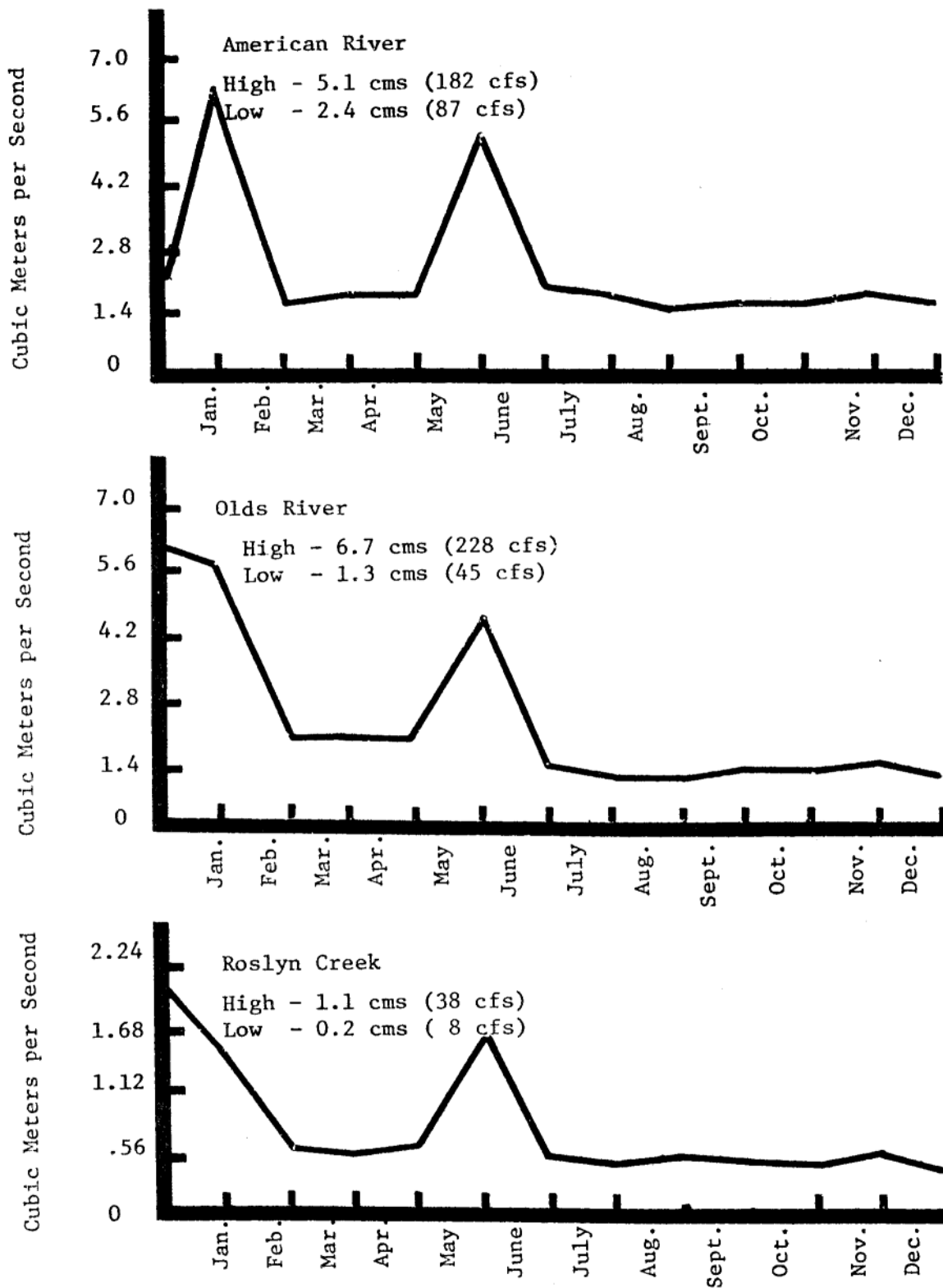


Figure 2. Flow Readings for Roslyn Creek, Olds River and American River January, 1981 through December, 1981.

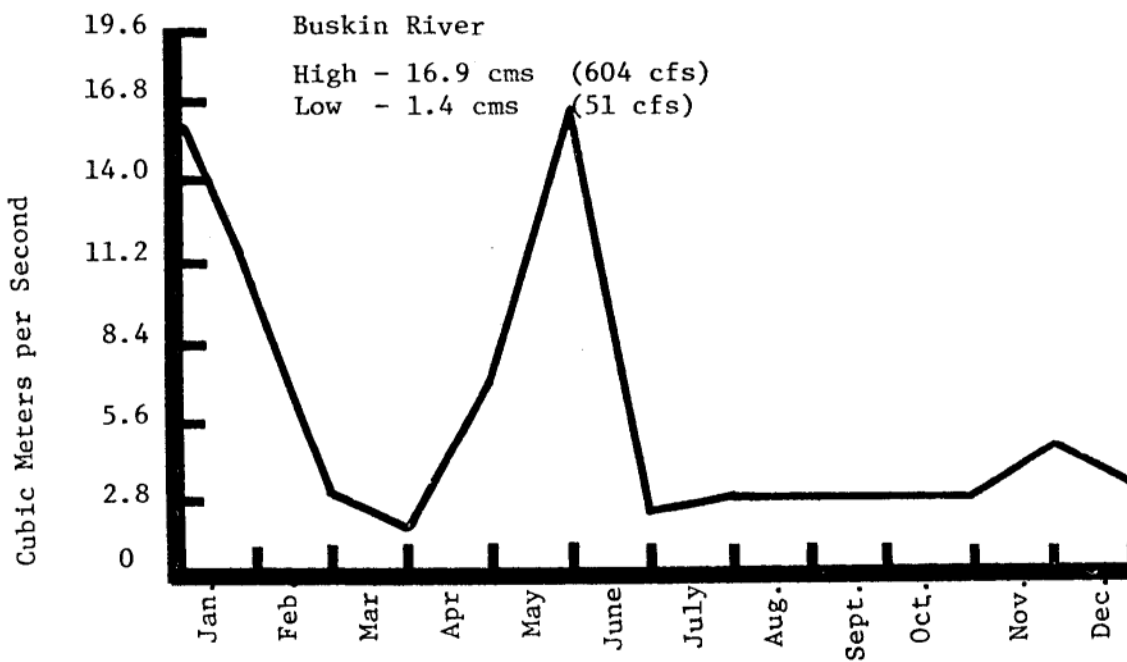
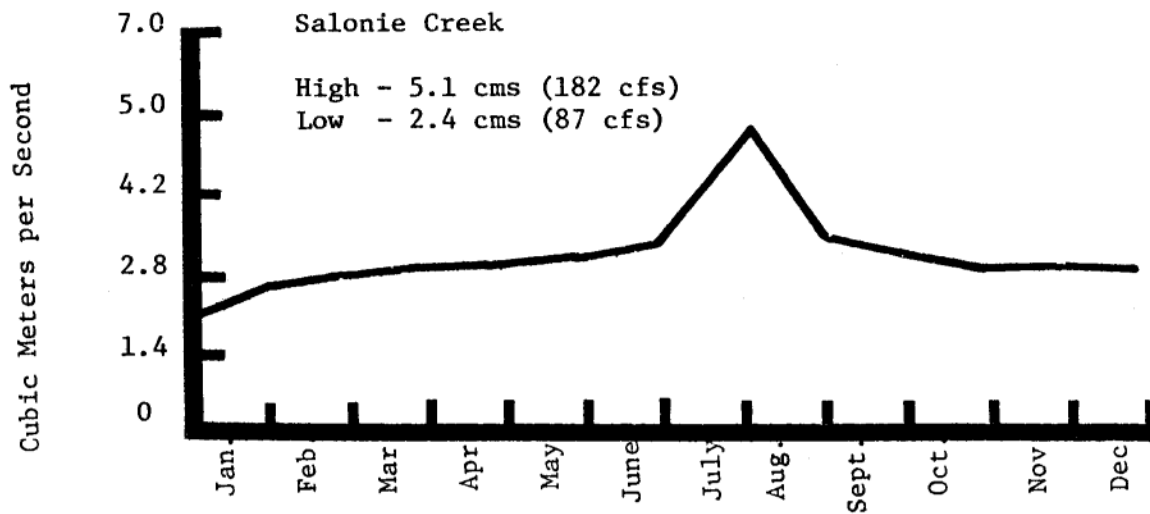


Figure 3. Flow Readings for Salonie Creek and Buskin River January, 1981 through December, 1981.

Table 10. Population Estimates of Tanignak Lake Rainbow Trout (Swanson River Strain),
From a Sequence of Three Samples, October 23 Through October 26, 1981.

		<u>Experimental Results</u>				<u>Summary Statistics</u>		<u>Estimates</u>	
Sample	Catch	Marked Recaptures	Number Dead or Injured on Capture	Number of Marked Released	Un-Marked Catch	Cumulative Un-Marked Catch	Number Previously Dead or Injured	N	S.E. (N)
<u>Age I Rainbow Trout:</u>									
1	450	0	1	449	450	450	0	...	...
2	598	113	4	594	485	934	1	2,377	+ 174
3	396	217	0	396	174	1,114	5	1,899	+ 70
<u>Age II and IV Rainbow Trout:</u>									
1	23	0	0	23	23	23	0	...	...
2	25	2	0	25	23	46	0	288	+ 186
3	16	7	0	16	9	55	0	1.5	+ 0.0

Table 11. Mayflower Lake Water Temperatures, Salinities and Bottom Samples Collected at Various Depths on August 28 and 31, 1981.

Depth (m)	Temp. (C)	Salinity*	Bottom Type	Aquatic Organisms
0.6	17.0	0.0		
0.9		0.0	Volcanic ash, fibrous detritus green vegetation	Fresh water mussel: 5.8 cm, 5.2 cm Caddis fly larva (case) Leach
1.2	17.0	0.0	No Sample	
1.8	16.0	0.0	Volcanic ash, fibrous and pulpy detritus, no green vegetation	Fresh water mussel: 5.2 cm Amphipods 4.6 cm 4.1 cm
2.4	16.0	0.0	No Sample	
2.7		0.0	Volcanic ash, fibrous and pulpy detritus, green vegetation	Fresh water mussel: 4.4 cm Amphipods 4.2 cm Caddis fly larva (case)
3.0	16.0	0.0	No Sample	
3.7	16.0	0.0	Volcanic ash, pulpy detritus, very little fibrous detritus	Fresh water mussel; 5.3 cm
4.3	16.0	0.0	No Sample	
4.6			Volcanic ash, fibrous and pulpy detritus, green vegetation	Diptera larva
4.9	16.0	0.75	No Sample	
5.5	16.0	5.0	Volcanic ash, pulpy detritus (hydrogen sulfide gas odor)	None
6.1	17.0	6.75	No Sample	
6.4			Volcanic ash, pulpy detritus (H ₂ S gas odor)	None

Table 11. (Cont'd) Mayflower Lake Water Temperatures, Salinities and Bottom Samples Collected at Various Depths on August 28 and 31, 1981.

Depth (m)	Temp (°C)	Salinity*	Bottom Type	Aquatic Organisms
6.7	16.0	7.5	No Sample	
7.3	16.0	7.5	Volcanic ash, pulpy detritus (H ₂ S gas odor)	None
7.9	16.0	8.0	No Sample	
8.2	15.0	9.0	Volcanic ash, small amount pulpy detritus (H ₂ S gas odor)	Fresh water mussel: 8.8 cm

* Parts per thousand.

A summary of daily water temperatures for the above streams, as presented in Table 12, shows Roslyn and Salomie Creeks received 1,940.5 °C and 1,707.6 °C temperature units, respectively. Data for American, Buskin and Olds River are incomplete as the thermographs stopped, were inaccurate or vandalized. However, temperatures for all streams were recorded during the critical over-wintering months. All streams reached a daily low of 0.0 °C during January and/or February, while only Buskin River reached the highest temperature (16.0°C) in August.

The above physical data provide vital information regarding the temperature and flow regimes under which fishes of the specific waters live. It will be helpful in establishing minimum flows and useful to correlate with annual fish production once stream surveys and specific fish survival information are completed and analyzed.

Big Kitoi Lake Rainbow Trout Brood Stock

An experimental rainbow trout egg take was conducted on Big Kitoi Lake during April and May 1981. A weir was installed on the major inlet April 10 through May 30, and fyke traps were fished in the lake 2 or 3 days per week from April 25 through May 25. Only two rainbow trout were observed below the weir and no fish were captured in the creek; however, four ripe females and four males were captured by fyke traps in or near the inlet. One spent female and one ripe male were also captured via hook and line in the lake. A total of 1,962 eggs were taken and incubated in the Kitoi Hatchery. Mortality on the fry was extremely high due to an unidentified disease; consequently, only a few fingerlings (less than 100) survived.

Since neither fyke-trapping nor the weir were successful in securing brood rainbow trout, 53 fish \geq 200 mm were captured via hook and line during mid-October 1981. These fish are being held on an experimental basis in a 2.1 m x 5.2 m silo. Only four fish to date have died and the rest appear in good condition. They have rejected commercially prepared fish food (Oregon Moist Pellet), but readily accept fresh frozen pink salmon eggs. These fish will be spawned in May 1982 and the resultant fry fingerlings will be stocked in Kodiak area research lakes.

Lake Water Chemistries

Analysis of water samples from 31 Kodiak-Afognak Lakes (Table 13) collected during September and October indicated the dissolved oxygen, total hardness (CaCO_3), total alkalinity (CaCO_3) and pH varied from 9.0-11.0 ppn, 6.8-80.0 ppm, 10.0-40.0 ppm and 6.38-6.75 units, respectively. The salinity for all waters was near 0.0 ppt and specific conductance ranged from 28-500 umho. Murray and Van Hulle (1974) determined most of the waters had similar chemical properties; i.e., all lakes were very soft (total hardness = 0-60 ppm) and chemical parameters fluctuated within a narrow range. The exception was Chiniak Lagoon which apparently receives saltwater influence and therefore is high in total hardness (80 ppm).

The ultimate objective of this sampling program is to establish a morphoedaphic index (MEI) value for each lake in order to gain a better understanding of lake productivity. Utilizing specific conductance for computing the index (specific conductance \div mean depth of the water body),

Table 12. Temperature Data for Five Kodiak Streams as Determined by Ryan Recording Thermographs January 1, 1981 through December 31, 1981.

Temp. °C	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
<u>Stream: American River</u>													
TU*	73.5	43.2	79.8	139.4	161.6	**	183.0	**	**	**	130.0	114.5	**
High	3.0	2.5	4.5	5.6	7.5	**	8.9	**	**	**	5.5	4.5	**
Low	1.0	1.0	1.5	2.2	3.3	**	3.9	**	**	**	3.5	3.0	**
Mean	2.4	1.5	2.6	4.6	5.2	**	5.9	**	**	**	4.3	3.7	...
<u>Stream: Buskin River</u>													
TU*	43.5	42.0	50.0	145.5	205.5	309.5	423.5	420.0	**	**	63.5	29.5	**
High	2.0	2.0	3.0	8.5	8.5	14.5	15.5	16.0	**	**	3.5	1.5	**
Low	1.0	1.0	1.0	3.0	5.0	6.5	11.0	12.0	**	**	0.5	0.0	**
Mean	1.4	1.5	1.6	4.7	6.6	10.3	13.7	13.5	**	**	2.1	1.0	**
<u>Stream: Old River</u>													
TU	57.0	59.	110.0	155.5	180.5	238.0	354.0	312.0	204.5	176.0	**	**	**
High	4.0	2.7	3.8	8.5	8.5	13.5	15.0	14.0	9.5	7.0	**	**	**
Low	0.0	0.0	0.5	3.0	4.0	6.0	7.5	8.5	5.0	4.0	**	**	**
Mean	1.8	2.1	3.5	5.2	5.8	7.9	11.4	10.1	6.8	5.7	**	**	...
<u>Stream: Roslyn Creek</u>													
TU	70.0	47.5	76.0	127.0	178.5	247.0	362.5	357.5	226.5	133.0	78.0	37.0	1,940.5
High	3.5	3.5	5.5	9.5	11.5	15.0	16.5	13.5	11.5	6.5	4.5	3.0	16.5
Low	1.0	0.5	0.5	1.5	2.5	5.0	7.5	8.0	3.5	1.0	0.5	0.0	0.0
Mean	2.3	1.7	2.4	4.2	5.8	8.2	11.7	11.5	7.6	4.3	2.6	1.2	...

Table 12. (Cont'd) Temperature Data for Five Kodiak Streams as Determined by Ryan Recording Thermographs January 1, 1981 through December 31, 1981.

Temp. °C	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
<u>Stream: Salonie Creek</u>													
TU	91.5	87.0***	101.0	142.5	145.1	180.1	211.4	215.8	168.6	148.7	123.9	92.0	1,707.6
High	3.5	...	6.5	8.8	5.5	9.4	9.4	10.0	7.8	6.7	5.0	3.9	10.0
Low	2.0	...	2.5	3.3	3.8	3.3	4.4	5.0	3.9	3.3	2.8	1.1	1.1
Mean	3.0	3.1***	3.2	4.8	4.7	6.0	6.8	7.0	5.6	4.8	4.1	3.0	...

* TU = Temperature Units

** Data not available - thermograph was inoperable

*** Thermograph inoperable .'. x temp. & TU are based on an average of data from the preceding and following month.

Table 13. Water Characteristics and Morphoedaphic Index Values of Selected Kodiak-Afognak Lakes, Sampled September-October, 1981.

Lake	Date	Temp. °C	Salinity (%)	Conductivity (MHo)	pH	Total Alk.* (ppm)	Total Hard.* (ppm)	Dissolved Oxygen (ppm)	MEI**
Abercrombie	10/07/81	6.5	0.0	130	6.75	26.0	30.0	9.5	10.0
Aurel	10/08/81	3.5	0.0	40	6.55	11.6	8.3	10.5	***
Buskin	09/16/81	10.5	0.0	48	6.45	12.0	8.0	10.0	***
Barry Lagoon	10/06/81	5.5	0.0	150	6.64	17.0	23.0	10.0	***
Beaver Pond	10/08/81	4.5	0.0	31	6.45	12.5	10.0	10.0	***
Big	10/05/81	6.2	0.0	96	6.58	40.0	32.0	9.0	***
Bull	10/06/81	5.0	0.0	48	6.60	14.0	12.0	11.0	***
Caroline	10/08/81	4.0	0.0	32	6.55	11.6	10.0	10.5	***
Cascade	10/15/81	5.0	0.0	35	6.63	17.5	15.0	10.0	2.3
Chiniak Lg.	10/16/81	7.0	0.2	500	6.60	21.6	80.0	10.0	***
Cicely	10/08/81	5.0	0.0	25	6.48	13.3	8.3	11.0	***
Dark	10/07/81	5.2	0.0	62	6.68	23.0	19.0	10.0	***
Delphin Bay	09/30/81	8.5	0.0	75	6.68	22.0	6.0	9.0	***
Dolgoi	10/13/81	6.0	0.0	155	6.74	20.0	30.0	10.0	***
Dragonfly	10/15/81	6.5	0.0	36	6.38	13.3	10.0	10.0	5.1
Genevieve	09/11/81	14.5	0.0	70	6.60	12.0	7.0	9.5	2.9
Heitman	10/15/81	6.0	0.0	32	6.46	10.0	7.5	10.0	***

Table 13. (Cont'd) Water Characteristics and Morphoedaphic Index Values of Selected Kodiak-Afognak Lakes, Sampled September-October, 1981.

Lake	Date	Temp. °C	Salinity (%)	Conductivity (MHo)	pH	Total Alk.* (ppm)	Total Hard.* (ppm)	Dissolved Oxygen (ppm)	MEI**
Horseshoe	10/15/81	5.8	0.0	48	6.65	13.3	13.3	10.0	7.6
Island	10/07/81	6.5	0.0	75	6.75	26.0	24.0	9.5	6.6
Jack	10/08/81	2.5	0.0	28	6.50	11.6	8.3	11.0	5.6
Lee	10/08/81	2.8	0.0	28	6.52	11.6	8.3	10.0	4.0
Lilly Pond	09/16/81	11.0	0.0	60	6.58	11.0	8.0	11.0	10.0
Lupine	10/06/81	4.2	0.0	52	6.72	20.0	18.0	10.5	***
Long	10/13/81	6.5	0.0	84	6.62	13.3	20.0	9.5	7.4
Louise	10/16/81	6.5	0.0	55	6.46	16.6	16.6	9.5	***
Margaret	10/16/81	6.0	0.0	70	6.55	21.6	21.6	10.0	***
Orbin	10/08/81	4.0	0.0	30	6.65	15.0	10.0	10.5	***
Pony	10/16/81	6.0	0.0	66	6.45	13.3	13.3	10.0	***
Southern	10/13/81	6.0	0.0	155	6.68	20.0	33.3	10.5	***
Tanignak	10/23/81	6.0	0.0	60	6.50	16.6	16.6	10.0	***
Twin (East)	10/06/81	5.8	0.0	75	6.62	18.0	14.0	10.5	***

* CaCO₃

** MEI (Morphoedaphic Index) = conductance divided by mean depth.

*** Data not available for morphoedaphic index computation.

10 lakes were found to have a MEI range of 2.3 to 10.0. An index for the 21 remaining lakes was not computed, as hydrographic and/or volumetric data are not available. A comparison of the 10 indexes shows differences that are best left uninterpreted until comprehensive growth and survival information on stocked game fish are analyzed.

Development and Enhancement of Anadromous Fish Populations

Lake Rose Tead:

Chinook salmon have been stocked annually in Lake Rose Tead (Table 14), the head waters of Pasagshak River, since 1976 (Murray and Van Hulle, 1977-1981). The first returning adults were observed in 1979 (n=5) and 1980 (n=8), and the largest predicted return was to occur in 1981 (Murray and Van Hulle, 1980-1981). Both streamside and sport creel censuses have been, and will be, conducted to assess angler effort and the number of sport-caught chinook salmon.

The 1981 creel census, conducted on Pasagshak River between June 15 and August 19, indicated 3,294 anglers fished 7,247 hours and retained 495 pink salmon, 144 Dolly Varden, 169 sockeye salmon, 157 coho salmon and 12 chinook salmon. Sport anglers brought in 26 additional chinook salmon, and an additional 42 chinook salmon were observed in the lake for a total of 80 chinooks known to have returned in 1981. The 38 sport-caught Pasagshak chinook salmon as presented in Table 15 were composed of 26 males and 12 females. Scale analysis indicated all fish smolted at Age 1.0 and the dominate 1.3 Age class composed 73.7% of the sample. Age 1.3 males and females had respective mean lengths of 911.2 mm and 935.2 mm. The low number of Age 1.4 fish (n=1) and the high number of 1.3 fish were expected; i.e., 22,500 fry and 133,109 fry were stocked in 1976 and 1977, respectively. The absence of 0.3 fish, which should have returned from 14,261 smolt stocked in 1978, is not explained. These fish may have matured early and returned as jacks, unobserved in 1979.

Chinook salmon fry (n=134,784) stocked in Lake Rose Tead on May 27, 1981 averaged 0.81 g per fish or 1,235 fish/kg. Approximately 868 hours of minnow-trapping July 8-23; 255 hours of fyke-netting August 17-19 and 11 hauls with a 16.2 x 1.8 m bag seine August 12, 18 and 19 captured only four juvenile chinook salmon in the Lake Rose Tead system. Numerous threespine stickleback, juvenile coho and sockeye salmon, yellow bellied sculpins, flounder, adult sockeye and pink salmon and Dolly Varden were also captured.

Approximately 126,000 chinook salmon eggs were taken from 18 Chignik River females and fertilized with six males on August 30, 1981. An additional 41,000 eggs were taken from six Lake Rose Tead females and fertilized with five males on September 9, 1981. These eggs are incubating in the Kitoi Bay Hatchery and will be stocked in Pasagshak as fry in June 1982. Age-growth data for Chignik and Lake Rose Tead brood stock chinook are presented in Tables 16 and 17, respectively.

Table 14. Lake Rose Tead Chinook Salmon Plants and Year of Expected Return, Kodiak Island.

<u>Year Stocked</u>	<u>Number of Salmon Stocked</u>	<u>Year of Expected Return</u>	
		<u>Three Ocean Salmon</u>	<u>Four Ocean Salmon</u>
1976	22,500 fry	1980	1981
1977	133,109 fry	1981	1982
1978	14,261 smolt	1981	1984
1979	65,562 fry	1983	1984
1980	93,259 fry	1984	1985
1981	134,784 fry	1985	1986

Table 15. Age, Sex and Size Composition of Angler Caught Chinook Salmon from Pasagshak River, 1981.

Age Class	Males						Females						Other**		Total	
			Length (mm)		Weight(kg)				Length (mm)		Weight(kg)					
	n	%*	x	+S.D.	x	+S.D.	n	%*	x	+S.D.	x	+S.D.	n	%*	n	%*
1.0	7	29.1	282.1	76.3	0.4	0.2	...	...	...	...	...	...	...	...	7	18.4
1.1	1	4.2	356.0	0.0	0.7	0.0	...	...	...	...	...	...	...	...	1	2.6
1.2	1	4.2	648.0	0.0	2.5	0.0	...	...	...	...	...	...	...	...	1	2.6
1.3	15	62.5	911.2	86.0	10.1	2.8	8	88.9	935.2	31.1	10.6	1.1	5***	100	28	73.7
1.4	<u>0</u>	<u>0.0</u>	<u>...</u>	<u>...</u>	<u>...</u>	<u>...</u>	<u>1</u>	<u>11.1</u>	903.0	0.0	10.2	0.0	<u>...</u>	<u>...</u>	<u>1</u>	<u>2.6</u>
Total	24	100.0					9	100.0					5	100.0	38	99.9

* % Age Composition = age class ÷ total ageable fish.

** Samples without length and/or weight data.

*** Three females and two males.

Table 16. Age, Sex and Length of Chignik River Chinook Salmon Utilized for Brood Stock, 1981.

Age Class	Males				Females				Total	
	n	%*	Length (mm)		n	%*	Length (mm)		n	%*
			x	+S.D.			x	+S.D.		
1.3	3	50.0	980.0	47.7	5	27.8	977.0	31.1	8	33.3
1.4	<u>3</u>	<u>50.0</u>	1095.0	73.9	<u>13</u>	<u>72.2</u>	1024.5	47.0	<u>16</u>	<u>66.7</u>
Total	6	100.0			18	100.0			24	100.0

* % Age Composition = age class ÷ total ageable fish.

Table 17. Age, Sex and Length of Pasagshak River Chinook Salmon Utilized for Brood Stock, 1981.

Age Class	Males				Females				Total	
	n	%*	Length (mm)		n	%*	Length (mm)		n	%*
			x	+S.D.			x	+S.D.		
1.3	4	80.0	929.5	34.0	4	66.7	909.0	25.5	8	72.8
1.4	0	0.0	...	...	2	33.3	909.0	43.8	2	18.2
Regenerate Scale	1	20.0	1090.0	...	0	0.0	...	...	1	9.0
	5	100.0			6	100.0			11	100.0

* % Age Composition = age class ÷ total ageable fish.

Sport Fish Harvest Estimates

Buskin River:

A streamside creel census conducted on Buskin River between April 21 and May 17 indicated 4,222 anglers fished 7,816 hours and harvested 8,437 Dolly Varden. Fish (n=799) randomly sampled from angler creels, as presented in Figure 4, had a mean length of 294 mm and a range of 155 mm to 525 mm. Since 1971, the spring Dolly Varden harvest has dropped by approximately 6,000 fish and the mean size has been reduced by 43 mm. In addition, the harvest rate has dropped from a high of 2.03 fish per hour in 1971 (Murray and Van Hulle, 1972) to a low of 1.1 fish per hour in 1981. Because of increased fishing pressure, a reduction in Dolly Varden mean size and catch per hour and lack of population data, there is concern the population may be overharvested. To protect Buskin River Dolly Varden and concurrently permit an optimum sport harvest, it is mandatory that more biological information be collected to formulate prudent regulatory guidelines and a sound management program.

To help protect Buskin River Dolly Varden, the bag limit was reduced from 15 to 10 fish in 1981. This 33.3% bag limit reduction probably reduced the overall harvest by about 10%. Census data obtained in 1979 indicated only 10.7% of the total harvest came from angler bag limits exceeding 10 fish in number.

Coho Salmon Derby

The Lions Club Salmon Derby occurred on August 29-30 and September 5-6, 1981 as recommended by the Department. A total of 72 coho salmon were reported harvested from nine streams with most of the catch coming from Pasagshak (75.0%) and Buskin (6.9%) Rivers. A comparison of this derby with the 1979 U.S. Coast Guard Derby (Table 18) shows the 1981 harvest was 57.4% (n=97) less than 1979; however, it increased 51.6% in Pasagshak and decreased 33.3% in Buskin. These differences are probably due to the timing of the derbies. All fishing prior to September 11 is primarily in marine areas, as streams draining into St. Paul Harbor are closed above the highway bridges August 1 through September 10. Pasagshak is not in the closure and therefore receives more effort. Holding the derby while most of the roadside streams were closed to salmon fishing appeared to (1) spread the effort to four additional streams; (2) reduce the total harvest and total angler effort; (3) significantly reduce the catch on Buskin River; and (4) significantly increase the catch on Pasagshak River.

Assessment and Inventory of Anadromous Fish Populations

Data reflected in Table 19 show escapement counts of the respective salmon species through weirs operated on Kodiak and Afognak Island.

Fish escapement estimates through the Karluk Lagoon weir between May 20 and September 22, 1981 were 7,575 chinook salmon, 2,195 steelhead kelts, 24,792 coho salmon, 164 upmigrant steelhead trout, 51,248 pink salmon and 222,706 sockeye salmon (Table 19). Table 20 presents weekly counts of the former three species, while Table 21 displays age, length and sex of angler-caught chinook salmon.

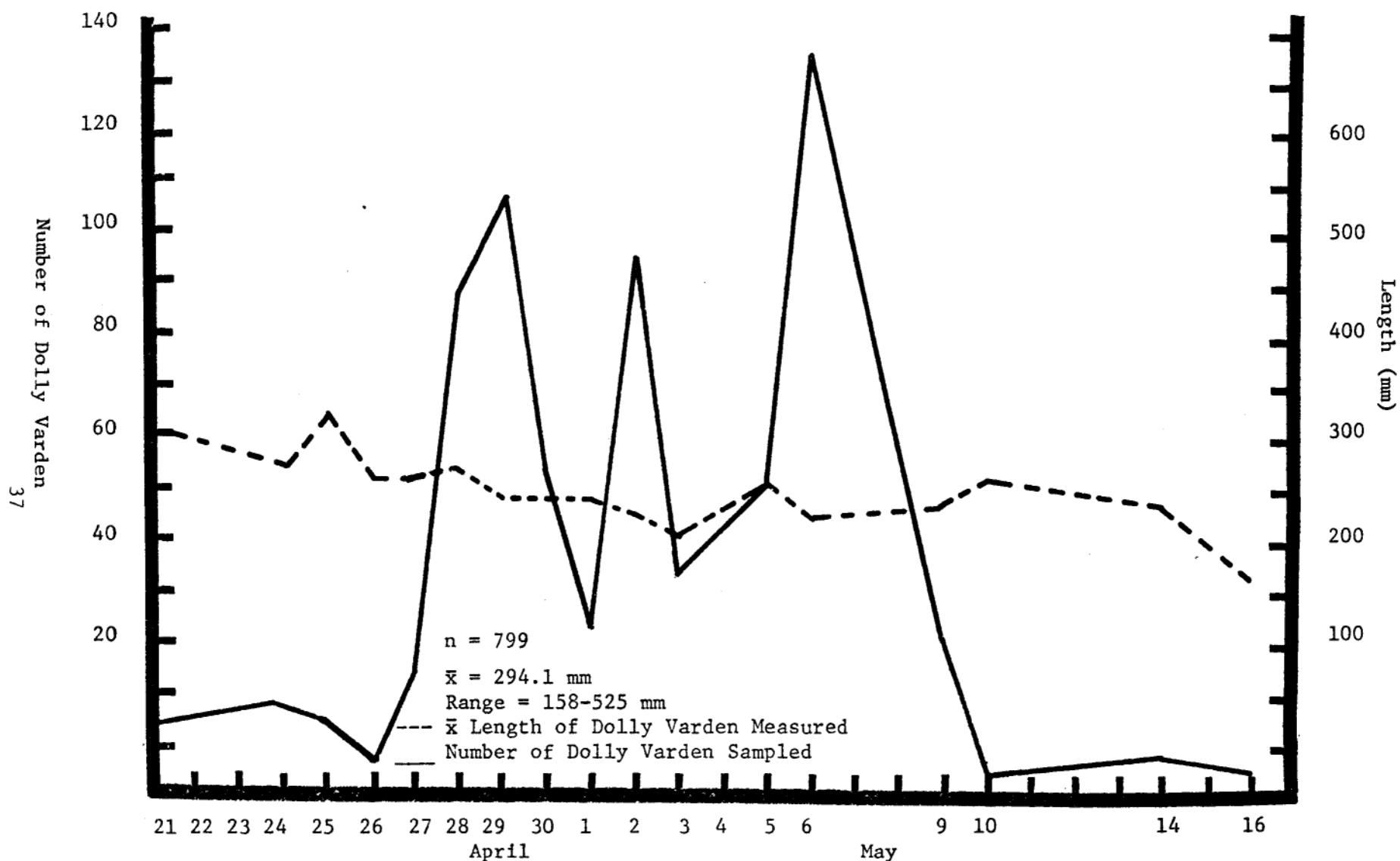


Figure 4. Number and Mean Length of Buskin River Dolly Varden Sampled from Angler Creels, April and May, 1981.

Table 18. Number and Percent of Coho Salmon Entered in the U.S.C.G. Salmon Derby September 8-9 and 15-16, 1979 and the Lions Club Salmon Derby August 29-30 and September 5-6, 1981.

Area	Number of Fish Harvested							
	1979				1981			
	Males	Females	Total	Percent	Males	Females	Total	Percent
Buskin R.	44	24	68	40.2	4	1	5	6.9
Pasagshak R.	25	7	32	18.9	33	21	54	75.0
Roslyn Creek	11	1	12	7.1	2	0	2	2.8
Womans Bay	13	9	22	13.0	0	3	3	4.2
Chiniak Creek	3	3	6	3.6	0	0	0	0.0
Olds River	6	2	8	4.7	0	0	0	0.0
Saltery River	15	6	21	12.4	1	0	1	1.4
Kalsin	0	0	0	0.0	3	1	4	5.6
American	0	0	0	0.0	0	1	1	1.4
Middle Bay	0	0	0	0.0	1	0	1	1.4
Selief Bay	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.0</u>	<u>0</u>	<u>1</u>	<u>1</u>	<u>1.4</u>
Total	117	52	169	99.9	44	28	72	100.1

Table 19. Escapement Counts Through Weirs on Kodiak and Afognak Islands, 1981.

River	Sockeye Salmon	Chinook Salmon	Pink Salmon	Chum Salmon	Coho* Salmon	Steelhead* Kelts	Up
Afognak	52,370	...	4,377	6	4,350	3	1
Upper Station	180,988	...	1,506	...	7,733	...	15
Ayakulik	274,200	8,018	4,358	214	392	1,108	...
Dog Salmon	377,716	22	11,124	85	...	...	...
Karluk Lagoon	222,706	7,575	51,248	286	24,792	2,195	164

* Total coho and steelhead escapements were not counted as all weirs were removed in August or early September.

Table 20. Summary of Chinook, Coho and Steelhead Migrational Timing as Determined by Partial Enumeration Through Karluk Lagoon Weir, 1981.

Period	Chinook		SH Kelts		UP SH		Coho	
	No.	%	No.	%	No.	%	No.	%
May 20-26	82	1.1	6	0.3	...	...	...	...
May 27-June 2	351	4.6	41	1.9	...	...	...	...
June 3-9	1,694	22.4	892	40.6	...	...	...	...
June 10-16	2,656	35.1	584	26.6	...	...	...	...
June 17-23	1,369	18.1	209	9.5	...	...	...	...
June 24-30	959	12.6	207	9.4	...	...	...	...
July 1-7	227	3.0	14	0.6	...	...	...	...
July 8-14	88	1.2	133	6.1	...	...	...	...
July 15-21	66	0.9	35	1.6	...	...	...	...
July 22-28	39	0.5	3	0.1	...	...	...	...
July 29-August 4	28	0.4	4	0.2	...	...	...	...
August 5-11	4	...	52	2.4	2	1.2	3	...
August 12-18	2	...	8	.4	1	0.6	638	2.6
August 19-25	8	0.1	4	0.2	5	3.0	358	1.4
August 26-Sept. 1	2	...	...	...	10	6.1	933	3.8
September 2-8	...	...	...	...	7	4.3	534	2.2
September 9-15	...	...	3	0.1	110	67.1	17,060	68.8
September 16-22*	...	...	...	...	29	17.7	1,696	6.8
September 22**	...	...	...	...	...	...	3,570	14.4
Total	7,575	100.0	2,195	100.0	164	100.0	24,792	100.0

* Weir removed on September 22.

** Estimated number of fish below weir on day it was removed.

Table 21. Age, Sex and Length of Angler Caught Chinook Salmon from Karluk River, 1981.

Age Class	Males				Females				Total	
	n	%*	Length (mm)		n	%*	Length (mm)		n	%*
			x	+S.D.			x	+S.D.		
1.3	4	16.0	843.7	93.9	3	8.6	809.3	21.0	7	11.7
1.4	20	80.0	924.8	48.8	28	80.0	911.7	45.9	48	80.0
2.4	...	...	...	...	2	5.7	909.5	0.7	2	3.3
Regenerate Scales	1	4.0	610.0		2	5.7	750.0		3	5.0
Total	25	100.0			35	100.0			60	100.0

* % Age Composition = age class ÷ total ageable fish.

Age 1.3, 1.4 and 2.4 chinook salmon comprised 100% of the 60 fish sampled. The dominant 1.4 Age class contained 20 males and 28 females with respective mean lengths of 924.8 mm and 911.7 mm.

Peak salmon escapement estimates for northeast Kodiak Island, as presented in Table 22, indicated 307,600 pink salmon, 12,210 chum salmon, 53,505 sockeye salmon and 6,845 coho salmon spawned in 18 roadside streams. These peak counts were similar to previous years' escapements.

Buskin River Steelhead Trout:

A total of 28 adult steelhead trout were observed in Buskin River via foot and boat surveys on May 26, 1981. Eighteen fish were observed between Buskin Lake and the Beaver Pond and the balance (n=10) was seen between the pond and Bridge Three. This was the largest spawning escapement observed since the river was closed to steelhead trout fishing in 1970.

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Table 22. Peak Salmon Escapement Estimates, N.E. Kodiak Island, 1981.

System	Chum Salmon		Coho Salmon		Pink Salmon		Sockeye Salmon	
	Date	Escpmt.**	Date	Escpmt.*	Date	Escpmt.**	Date	Escpmt.
American	August 22	2,500	October 30	627	August 22	54,000	NA	...
Buskin	NC	...	October 28	919	August 28	88,000	August 14	7,846**
Chiniak	NC	...	November 2	170	July 27	650	NA	...
Hurst	August 22	1,000	NC	...	August 22	6,050	NA	...
Kalsin	NC	...	October 27	181****	NC	...	NA	...
Monashka	NC	...	October 28	57	August 26	1,300	NA	...
Myrtle	NC	...	NC	...	August 22	2,600	NA	...
Olds	August 22	500	October 29	439	August 22	73,000	NA	...
Panamaroff	NC	...	November 2	41	NC	...	NA	...
Pasagshak	August 4	500	October 27	2,621	August 4	2,000	August 26	2,759**
Pillar	NC	...	October 28	33	August 26	400	NA	...
Roslyn	July 25	10	October 22	314	July 25	1,500	NA	...
Russian	August 22	500	October 26	47	August 22	5,600	NA	...
Salonie	August 22	200	October 25	393	August 22	10,000	NA	...
Saltery	August 4	7,000	November 5	959*****	August 4	57,000	August 4	43,300***
Sargent	NC	...	October 26	44	August 22	1,400	NA	...
Twin	NC	...	NC	...	NC	...	NA	...
#410	NC	...	NC	...	July 27	4,100	NA	...
Total		12,210		6,845		307,600		53,905

* Foot Survey

** Boat Survey

*** Aerial Survey

**** Includes 15 SS observed in Kalsin Pond

***** Outlet only

NC = No Count

NA = No Applicable

Note: 42 chinook salmon were observed via aerial survey August 24 in Pasagshak River.

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